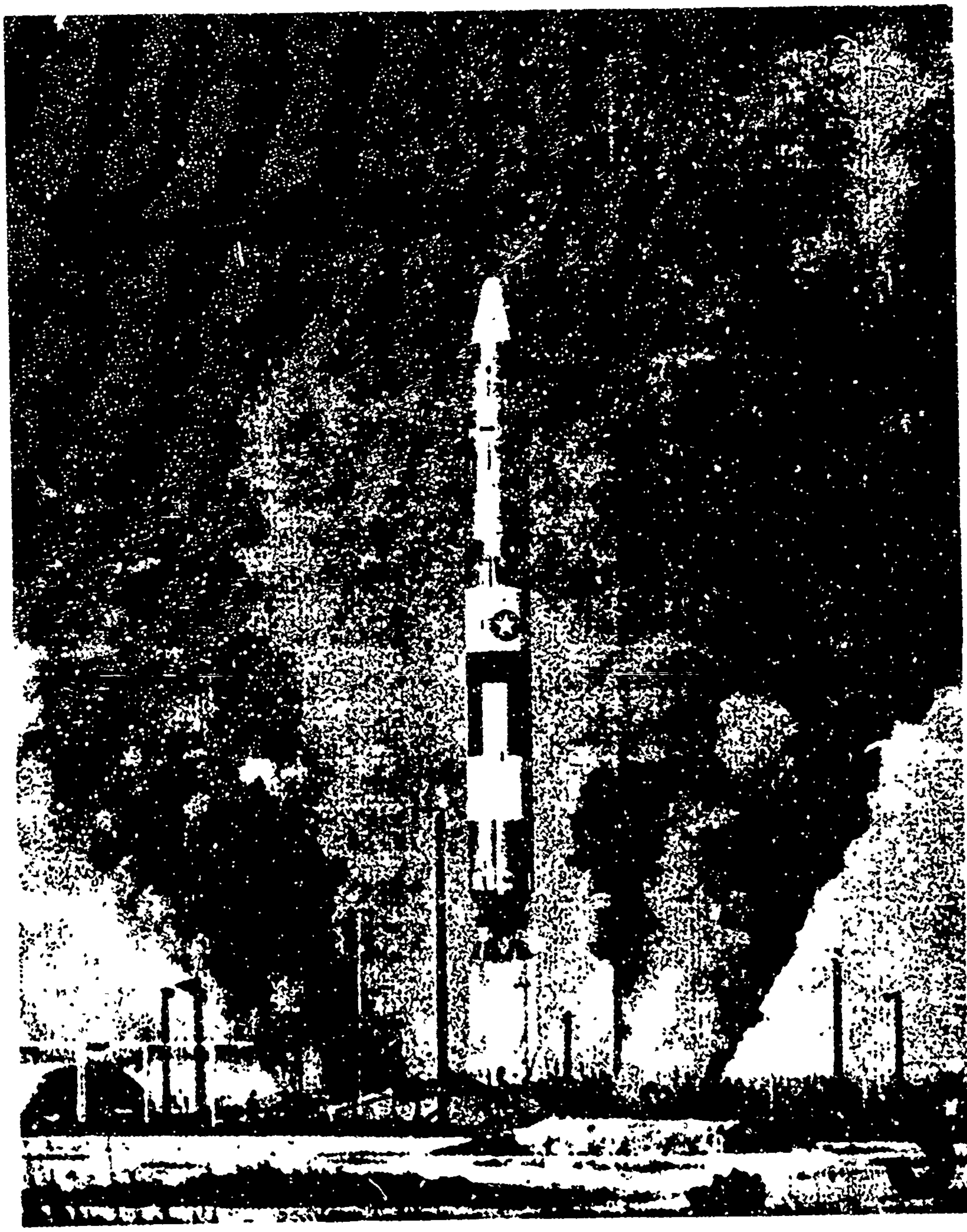
TITAN II

RELIABILITY AND AGING SURVEILLANCE PROGRAM

(RASP)

ENGINEERING TEST REPORT NO. 25



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RASP ENGINEERING

REPORT NO. 25

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1.0 INTRODUCTION

This report provides the results of RASP Phase I and Phase IA testing as completed for Missile Airborne and Ground Support Systems. identified as follows:

Date	Test Type	Missile No.	Complex
25 Mar-1 May 81	Phase I	B-79	533-5
12-27 Feb 1981	Phase IA	B-74/29	571-9
15-25 June 1981	Phase IA	B-63	374-2

The Phase I testing is conducted in conjunction with the missile recycle and removal of the engines for testing under the Service Life Analysis Program (SLAP), and includes special and critical testing of all airborne and ground support equipment for aging trends. Phase IA testing does not involve Recycle, SLAP Testing or Downloading of Propellants, but includes testing of all critical airborne and support equipment for launch readiness verification, aging trends, logistic support, special testing or inspection requirements.

Table 1 summarizes the RASP Phase I and Phase IA Tests which have been completed to date.

The data collected during RASP testing are reduced, analyzed and applied to the Titan II Weapon System Mathematical Model to produce estimates of system reliability. The actual system reliability estimates obtained are reported in the OO-ALC System Effectiveness Report (RCS LOG-MM(Q)7372).

2.0 BACKGROUND

The Titan II Reliability and Aging Surveillance Program (RASP) has two basic objectives; first, to provide a source of test data which, when coupled with past and future flight test data, will provide an adequate basis for calculation of a meaningful weapon system reliability estimate; second, provide a source of test data to monitor the effects of age and the maintenance environment on the performance of equipment such that with good management, the high reliability of this system may be maintained throughout its operational life.

Testing is accomplished primarily at three levels. (1) The In-Silo Testing is primarily an over-all complete systems oriented test. (2) The Maintenance and Electrical Cable checks. (3) The Laboratory Testing is performed on specific components which have been removed from the missile for evaluation testing.

Flow charts for Phase I and Phase IA test requirements are included in T.O. 21M-LGM25C-103.

3.0 ACKNOWLEDGEMENTS

Appreciation is expressed to the SAC personnel of all three Titan II Wings for their support in accomplishing the field level testing of the systems covered by this report. Delco Electronics provided analysis of the Guidance System test data. Aerojet Liquid Rocket Company (ALRC) performed the evaluation of the Propulsion System. Martin Marietta Aerospace personnel performed the airborne wiring resistance leakage check, the airframe inspection, and many of the missile component tests. The remaining testing and analysis was accomplished by TRW/DSSG.

4.0 SUMMARY OF TEST RESULTS

4.1 Missile B-79 and Complex 533-5

RASP Phase I Testing of Missile B-79 and Complex 533-5 was successfully completed with no major equipment anomalies observed. Missile and complex systems operational tests indicated that the weapon system and equipment would have supported a successful missile launch. The minor problems encountered are discussed in context of the test sequences as outlined under Section 5.0 of this report.

4.2 Missile B-74/29 and Complex 571-9

The Phase IA RASP Test was conducted on the missile and complex systems in conjunction with an scheduled fuel downloading of Stage II that was due to fuel vapor presence below Stage II fuel prevalve. Results of systems testing indicate the systems would have supported a successful launch. The anomalies are discussed under appropriate test sequence descriptions of Section 6.0, this report.

4.3 Missile B-63 and Complex 374-2

Results of Phase IA RASP Testing on missile and complex systems indicate that the systems were in the ready state and would support a successful missile launch.

5.0 PHASE I TEST-MISSILE B-79 AND COMPLEX 533-5

5.1 General

This section presents the major results of Phase I RASP Testing of Missile B-79 and Complex 533-5 as completed during the period between 25 March and 1 May 1981 at McConnell AFB, Kansas.

5.2 Missile B-79 History

Missile B-79 was accepted by the Air Force in May of 1964 and shipped from Martin Co. to McConnell AFB. It was installed in Complex 533-7 in December 1964. It was removed from Complex 533-7 in June of 1965 due to a Stage I oxidizer tank leak and shipped to Martin Co. in August of 1965. The missile was shipped from Martin Co. to HAFB on July 1966, and then shipped to VAFB in August of 1966. It was installed in Complex 395-D on September 1966. In January of 1970, it was deactivated and removed from Complex 395-D and shipped to HAFB in Feb. 1970. The missile was then shipped to McConnell AFB in December of 1971 and installed in Complex 533-5 in July of 1972 where it remained on alert status except for the down-loads as performed for pre-valve and gasket seal replacement.

May 1973	Stage II Fuel	Pre-valve
June 1976	Stage I & II Oxidizer	Gasket Seals
Mar. 1979	Stage I & II Oxidizer	Gasket Seals

In May of 1981, the missile was removed from Complex 533-5 for RASP and SLAP Testing Requirements.

5.3 Coded Switch System (CSS) and Combination System (CST) Tests

The CSS test was successfully performed at Complex 533-5 at the start of the Combined Systems Test. The CSS Butterfly Valve Lock (BVL) is recoded after the Start Cartridges are removed from the complex. (This recoding is accomplished so that the BVL can be opened without revealing the operational code). The maintenance code is then dialed into the Butterfly Valve Lock Control (BVLC). The BVL then unlocks the lock if the maintenance code dialed matches the code previously stored in the BVL. As soon as this is accomplished, the launch keys are turned to initiate the CST.

A CST provides a go/no-go indication of the launch control equipment, OGE, OGE-to-missile interface, airborne wiring, and the IGS-to-flight controls interface. A successful CST was conducted at Complex 533-5 on 3 April 1981. All ordnance simulation fuses fired and the events recording was normal.

5.4 Operating Ground Equipment (OGE) Tests

5.4.1 Electrical Umbilical Test and Inspection

Four electrical umbilicals connect power and signal circuits between ground equipment and the missile during alert standby and the launch sequence. During the final launch sequence, the umbilicals are disconnected by a lanyard-operated mechanism. Failure of the umbilicals to conduct the required signals and ground power, or to release from the missile within force limitations, can result in a launch and/or flight failure. The ability of the electrical umbilicals to perform their required prelaunch and launch sequence functions is determined through the test described as follows:

a. A Missile Verification (MV) and a Combined Systems Test (CST) are performed to determine that continuity exists for all critical launch circuits.

b. An electrical umbilical pull test is performed to determine the force required for breakaway of the umbilicals from the missile.

c. A visual inspection of umbilical hardware and of the mating surfaces of the umbilical and missile connectors for contamination, corrosion and other physical damage.

d. A successful MV and CST were accomplished on Missile B-34, thus proving that all connections were available for launch.

e. The measured breakaway force for each of the four umbilicals during the pull test are presented below. The visual inspection performed on umbilical hardware indicated no discernable damage, corrosion or contamination.

B-79 Umbilical Pull Test Results

Designation	Disconnect Force (Lbs)	Required Force (Lbs)
2B2E	160	70-200
2B1E	185	70-200
3B1E	155	70-200
3D1E	130	70-200

5.4.2 Thrust Mount and Shock Isolation System Test

a. A visual alignment check and a lockup exercise was performed during the Launch Verification test to verify proper system performance.

b. An external inspection of system components for corrosion, damage, and missing hardware was performed and no major problems were found.

c. The static equilibrium (stickout) test was performed and the proper vertical and horizontal alignment with all dampers was verified. Table 5-2 shows the results of the test. The maximum deviation between initial damper reference mark and the damper readings after each stickout pull was 2/32 inch. The maximum allowable deviation is 7/32 inch on a properly aligned system.

5.4.3 Silo Closure Door

The Silo Closure Door System consists of the HS-1 hydraulic system, maintenance control panel, door opening and closing buffers, and the associated test equipment and controls. The door is designed to open within 19±2 seconds following initiation of appropriate signal from CMG-1 and is a necessary prerequisite to a missile launch.

The Silo Closure Door Operation Timing and Capabilities Test determines the HS-1 System capability during one complete timed cycle. The incremental times for open and close functions are listed below.

Complex 533-5 Incremental Door Time

Function (Sec)	Recorded Time	T.O. Requirement
Unlock "T" Locks	1.3	1.5 ± 0.5
Lower "T" Locks	5.0*	2.5 ± 0.5
Raise Rail Bridge Jacks	2.3	2.0 ± 0.5
Door Roll Open	13.2	13.0 ± 1.0
Total Door Opening	22.5*	19.0 ± 2.0

*Out of Tolerance:
Recommendations were made to service the precharge and complete a re-run of the test. If time increments remain out of tolerance, adjustment of directional control valve or flow control valve is required.

Accumulator Capability

Function Level	Nitrogen (PSIG)	Hydraulic (PSIG)	Fluid (INCHES)
Start	3500	3500	1.5
Door Open	3000	3000	4.5
Door Closed	2750	2750	10.25
Hyd. Fluid Reservoir	2700	0	14.0
System Rechange	3500	3500	2.3

Test Date: 30 March 1981

TABLE 5-2

533-5 Static Equilibrium Test Results

Pull Test Number	Launch Duct Orientation (Deg)	Component Condition (D=Deflected) (R=At Rest)	Deviation From Reference (inch) By Quadrant Number			
			I	II	III	IV
1	0	V Dampers (D)	-13/32	+13/32	+15/32	- 8/32
		H Dampers (D)	- 7/32	+12/32	+ 8/32	-13/32
		V Dampers (R)	+ 1/32	0	0	0
		H Dampers (R)	0	+ 2/32	0	0
		Level 2 (R)	+ 1/32	+ 2/32	0	0
2	90	V Dampers (D)	-10/32	-15/32	+12/32	+17/32
		H Dampers (D)	+13/32	+10/32	-13/32	-10/32
		V Dampers (R)	+ 1/32	0	0	+ 1/32
		H Dampers (R)	0	0	0	0
		Level 2 (R)	+ 1/32	0	0	+ 1/32
3	180	V Dampers (D)	+16/32	-13/32	-14/32	+14/32
		H Dampers (D)	+ 7/32	-10/32	-11/32	+14/32
		V Dampers (R)	0	0	0	0
		H Dampers (R)	+ 1/32	0	0	0
		Level 2 (R)	+ 1/32	0	0	0
4	270	V Dampers (D)	+12/32	+14/32	-10/32	-10/32
		H Dampers (D)	-11/32	-10/32	+10/32	+ 9/32
		V Dampers (R)	0	0	0	+ 1/32
		H Dampers (R)	0	0	0	0
		Level 2 (R)	0	0	0	+ 1/32

*References: Level 2 = 10 inches
Dampers = 2 inches

5.4.4 Missile and Facility Simulator Checks

The missile and facilities simulators are used to simulate the electrical functions which are monitored or controlled by the launch control, checkout, and monitor system.

Missile and facilities simulators are portable test sets which simulate the facilities sensors, Inertial Guidance System/-Operational Ground Equipment (IGS/OGE), and the OGE controls to verify the ability of the launch control set to detect and control hazardous conditions.

During the missile verification malfunction test, Fig. 2-10, step 43, T.O. 21M-LGM25C-2-11-1, the MFL failed to recognize a simulated actuator null malfunction. The MFL-3 drawer was checked out on the GEETS test set with no malfunction indicated. The probable cause of the malfunction was a stuck Relay in the MFL-3. The successful missile verification and MFL-3 tests performed on the missile indicate that the malfunction was only in the MFL test equipment and would not have effected the launch or flight of the missile.

5.4.5 CMG Rack Redundant Circuit Test

Most of the OGE launch critical circuitry undergoes complete checkout during a CST; however, a few circuits are redundant which preclude a check for all legs of the design redundancy. For this reason, a special set of procedures are used in RASP testing to isolate and check out all legs of redundant circuits.

The procedure calls for removal of all four CMG chassis and for their installation on the Guidance/Electronics Equipment Test Set (GEETS). The complete chassis checkout procedure contained in TO 31X2-10-27-2 is accomplished on the GEETS and, in addition, the redundant circuits in each chassis are isolated and checked.

The table below provides the serial numbers and findings for the CMG and MFL chassis tested on the GEETS.

Drawer	Removed S/N	Installed S/N	Discrepancies/Corrective Action
CMG-1	38	21	A-16 Board R&R
CMG-2	84	33	None
CMG-3	29	14	R-9 on A2 Board Reg. Adj. M2 (15 min) Timer R&R
CMG-4	17	53	None
MFL-1	15	22	None
MFL-2	48	43	A7 Board loose
MFL-3	83	80	None
MFL-4	81	25	R5 on A5 Board Reg. Adj. R4 on A6 Board Reg. Adj. R6 on A6 Board Reg. Adj.

The discrepancies noted during the check out of the drawers on the GEETS test stand were all minor in nature and would not have effected launch of the missile.

In addition to the chassis checkout, a procedure for verifying the integrity of all legs of the redundant wiring in the CMG rack at Complex 533-5 was accomplished. The test indicated that no discrepancies existed in the rack redundant wiring.

5.4.6 OGE Power Supply Equipment Checks

The OGE Power Supply Equipment consists of a power distribution control rack, two 28 vdc power supplies, two 28 vdc battery power supplies, and two interconnecting boxes.

Testing and inspection of this equipment during Phase I RASP tests consists of the following:

a. A visual inspection of the power supplies, and battery power supplies for general condition and critical operating parameters.

b. A battery transfer test which checks the capability of the power distribution control to automatically switch the 28 vdc Battery Power Supply #1 to the Readiness Bus if the regular 28 vdc power voltage drops below 27.8 vdc.

c. Terminal tightness checks of the terminals in interconnecting boxes JEU-18 and JEU-19 was completed and found satisfactory.

d. Battery transfer testing - The transfer of the backup battery to the Readiness Bus was performed two times at Complex 533-5, and all transfer functions operated normally. One transfer was accomplished at the power supply and one by turning off Circuit Breaker in DP-2. The Readiness transfer and the voltage required to trigger the Silicon Control Rectifier (SCR) are shown below:

	Run 1	Run 2	Average
Readiness Bus Transfer Voltage (vdc)	28.3	27.6	27.9
CR4 Transfer Duration (ms)	3.6	4.4	4.0
Readiness Bus Voltage After Transfer (vdc)	29.03	28.5	28.7
SCR Trigger Voltage (vdc)	1.16	1.16	1.16

e. A battery capacity test was performed on one set of 26 cells each. The set from Complex 533-8 were installed 8 Nov 79 and removed 4 May 1981. The individual cells of the unit were checked prior to the testing and each cell satisfied the design specifications. A discharge rate of 45 amperes was established and was continued until the set voltage dropped below 22 VDC. The set was serviceable above 22 VDC for six hours and 15 minutes (288 ampere hours). The battery set exceeded the requirements of TO 35C1-2-62-2 and the Titan II specifications.

The parameters recorded for the power supplies and battery power supplies during the inspection are shown below.

533-5 OGE Electrical Parameters

Parameter	Measurement	Normal Limits
Power Supply #1 Output (vdc)	31.3	29.5 - 32
Power Supply #2 Output (vdc)	30.5	29.5 - 32
Battery Power Supply #1 Output (vdc)	30.3	31 minimum
Battery Power Supply #2 Output (vdc)	33.0	31 minimum

5.4.7 Facility Single Point Ground Check

The purpose of the single point ground system is to maintain identical voltage potentials within the missile electrical system on all circuits. The ground system also protects the missile electrical system from power transients from the facility electrical equipment. A minimum of 100,000 ohms of resistance is required between the missile electrical system ground and facility ground.

The single point ground check for a RASP Phase I test is performed after removal of the missile under test and is part of the normal activity to install and bring up the replacement missile to alert status.

The first resistance reading taken at 533-5 was 40,000 ohms. Trouble analysis was performed which resulted in 3 facility circuits being isolated. The resistance reading was then recorded at 5,000.000 ohms. The 3 facility circuits were documented as requiring maintenance.

5.4.8 Launch Duct Humidity Check

A check of the launch duct air humidity is made using a sling psychrometer on Levels 2 and 7 of the launch duct and the relative humidity from the dehumidifier, D-101, on Level 8 is obtained. The following were the measurements taken at Complex 533-5:

	Relative Humidity (%)	T.O. Requirements (%)*
Level 2 Launch Duct	35%	30% MAX
Level 7 Launch Duct	35%	30% MAX
Level 8 Dehumidifier	45%	Ambient Reference

*SAC CEM 21-SM68B-2-20-Series

Even though the relative humidity measured higher than the T.O. requirements, equipment was functioning normally. The readings were taken during the morning and this could attribute to the out-of-tolerance readings due to personnel traffic in and out of launch duct access doors.

5.5 Missile Airframe

5.5.1 Inspection

The B-79 airframe was inspected and checked in the MIMS at McConnell AFB. The checks consisted of visual surface inspection, X-ray photography and dye penetrant inspection as applicable to five areas.

a. Stage I and II Oxidizer and Fuel Tank Outlets and Crossovers.
b. Stage I Fuel Tank Extruded K-Frame
c. Apex Area of Stage II Fuel Tank aft Cone and Forward Dome.
d. Missile Skin
e. Longerons

5.5.2 Airborne Electrical

a. The Missile Isolation Resistance reading was within the expected value range of 10,000 ohms and the Airborne Capacitor Value was found to be within the specification tolerance.

b. During the Airborne Connector Inspection, no major corrosion or contamination problems were discovered, but two connectors were written-up for a potential alignment problem.

c. Motor Driven Switches.

There are 8 Motor Driven Switches (MDS's) which are utilized on the Titan II missile electrical system to transfer signals during launch and flight and to isolate ordnance circuits during normal standby alert. All eight of these switches are exercised during a Combined Systems Test (CST).

d. Table 5-1 provides the MDS performance results for Missile B-79. The data were obtained in conjuction with the RASF CST. All switches transferred and their performance was within T.O. limits.

5.5.3 Airborne Hydraulics

The electric driven hydraulic pump noise test was performed and the voltage values observed were well within the established requirements.

5.6 Propulsion System Summary

The propulsion system on Missile B-79 was comprised of LR87-AJ-5 Engine SN 9510102 and LR91-AJ-5 Engine SN 9520107. Background information is provided on these engines in Table 5.6-A.

TABLE 5-1

Missile B-79 Complex 533-5 Motor Driven Switch Performance

Switch Position	Function	Type Switch (amp)	First Cycle Time (msec)	System** Requirement	T.O. Req'mt. Time (msec)	% Local Current	T.O. Req'mt. %Local Current
*685K2	Stage I Engine Start Switch	20	55	1 sec	72	16	75
*685K1	Stage I Prevalve Switch	20	55	1 sec	72	33	75
*364K2	Stage I Staging and Shutdown Switch	20	56	200 sec	72	59	75
*331K3	Stage II Engine Shutdown Switch	20	58	197 msec	72	11	75
*364K1	Ordnance Safety Switch	20	54	1 sec	72	21	75
331K1	IGS Power Switch	20	64	1 sec	72	21	75
*331K2	APS Power Switch	200	44	1 sec	72	11	75
367K1	VHPS Power Switch	200	46	1 sec	72	12	75

*Original Equipment Switches
**Allowable Operational Tolerance

TABLE 5.6-A

STAGE I ENGINE SN 9510102

Date: 23 April 1981 Complex 533-5

FUNCTION	ALLOWABLE LIMITS	RESULTS/VALVES SUBASSEMBLY 1	SUBASSEMBLY 2
Turbo Pump Assembly Torque Check	Initial Break - 150 in.-lbs Final Break - 50 in.-lbs. Running (SA-1) - 39 in.-lbs. (SA-2) - 40 in.-lbs.	Initial Break - 48 ins.-lbs. Final Break - 34 in.-lbs. Running - 30 in.-lbs.	Initial Break - 60 in.-lbs. Final Break - 58 in.-lbs. Running - 32 in.-lbs.
		OHMS RESISTANCE	
Electrical Resistance Test	Squibs: 0.5 to 1.0 ohm	A1 - 0.7 ohm B1 - 0.9 ohm	A2 - 0.7 ohm B2 - 0.8 ohm
	PSVOR: 22° 5 ohms	22.3 ohms	22.4 ohms
	TCPS: 50 ° 5 K ohms	50.0 K ohms	49.9 K ohms
		LEAK RESISTANCE	
	Greater than 10 K ohms	Squib A1: 199.9 K ohms Squib B1: 199.9 K ohms PSVOR: 199.9 K ohms TCPS: 199.9 K ohms	A2: 199.9 K ohms B2: 199.9 K ohms PSVOR: 199.9 K ohms TCPS: 199.9 K ohms
Thrust Chamber Valves Functional Check	Open 750 to 998 milliseconds Close 700 to 900 milliseconds External Leakage - None	Open - 825 milliseconds Close - 793 milliseconds No Leakage	Open - 838 milliseconds Close - 813 milliseconds No Leakage
Turbine Hot Gas System and Gas Generator Leak Check	Turbine Seal - 750 cc/min Pressure Decay - 0 psig/5 min External Leakage - None Hot Gas Cooler Internal Leakage (SA-2) - None/10 min	No turbine seal leakage No pressure decay No external leakage Not applicable	No turbine seal leakage No pressure decay No external leakage No hot gas cooler leakage
	Fuel Autogenous Burst Diaphram (SA-2) - None	Not applicable	No burst diagram leakage

Table I. Stage I Engine Checkout (Sheet 1 of 3)

TABLE 5.6-B

STAGE I ENGINE SN 9510102 (cont.)

Date: 23 April 1981 Complex 533-5

FUNCTION	ALLOWABLE LIMITS	RESULTS/VALVES SUBASSEMBLY 1	SUBASSEMBLY 2
Fuel System and Fuel Pump Seal Leak	Pump Seal - 900 cc/min	No pump seal leakage	No pump seal leakage
	Oil Cooler Internal - None/8 min	No oil cooler leakage	No oil cooler leakage
	Pressure Decay - 2 psig/5 min	No pressure decay	No pressure decay
	External Leakage - None	No external leakage	No external leakage
Oxidizer System and Oxidizer Pump Seal Leak Check	Pump Seal - 900 cc/minute	25 cc/min seal leakage	No pump seal leakage
	Pressure Decay - 2 psig/5 min	No pressure decay	No pressure decay
	External Leakage - None	No external leakage	Minor, fuzz leakage through discharge line quick-disconnect
	Oxidizer Autogenous Burst Diaphragm (SA 2) - None	Not applicable	No burst diaphragm leakage
Gearbox and Gearbox Seals Leak Check	Fuel GB Seal - 300 cc/min	No fuel seal leakage	No fuel seal leakage
	Oxidizer GB Seal - 300 cc/min	No oxidizer seal leakage	No oxidizer seal leakage
	Pressure Decay - 0 psig/5 min	No pressure decay	No pressure decay
	External Leakage - None	No external leakage	No external leakage
Downstream Propellant Systems Leak Check	GGFCKV Reverse Flow 2 cc/min	No GGFCKV leakage	No GGFCKV leakage
	GGOCKV Reverse Flow - 2 cc/min	No GGOCKV leakage	No GGOCKV leakage
	Fuel System Pressure Decay - 0 psig/5 min	No pressure decay	No pressure decay
	Oxidizer System Pressure Decay - 0 psig/5 min	No pressure decay	No pressure decay
	External Leakage - None	No external leakage	No external leakage

Table I. Stage I Engine Checkout (Sheet 2 of 3)

TABLE 5.6-C

STAGE I ENGINE SN 9510102 (cont.)

Date: 23 April 1981

Complex 533-5

FUNCTION	ALLOWABLE LIMITS	RESULTS/VALVES SUBASSEMBLY 1	RESULTS/VALVES SUBASSEMBLY 2
TCPS Leak and Functional Check	Pressure Decay - 0 psig/5 min External Leakage - None	No pressure decay No external leakage	No pressure decay No external leakage
	TCPS "make" - 620 ° 20 psia TCPS "break" - 5 to 50 psia below "Make" pressure	"Make" 624 psia "Break" 594 psia	"Make" 619 psia "Break" 576 psia
Oxidizer Autogenous System Leak Check (SA 2 Only)	Pressure Decay - 0 psig/5 min External Leakage - None	Not applicable	No pressure decay No external leakage
Electrical Conduit Leak Check	Pressure Decay - 0 psig/2 min External Leakage - None	2 psig/2 min decay Insulation wrapping on conduit - LLD not applied	See SA 1
Lube Oil Drain	Qty - 8 pints (3785 milliliters) Dipstick and breaker measure Screen Contamination - None	Full on dipstick Breaker measurement not taken Engine being returned for SLAP - screen not removed for inspection	Full on dipstick Breaker measurement not taken Engine being returned for SLAP - screen not removed for inspection
	Magnetic Plug Contamination - None	No particles on plug	No particles on plug
Engine Dew Point	+ 35°F - Maximum	Fuel System + 41°F Oxidizer System + 40°F	Fuel System + 42° F Oxidizer System + 41°F

Table I. Stage I Engine Checkout (Sheet 3 of 3)

TABLE 5.6-D

STAGE II ENGINE SN 9520107

Date: 23 April 1981 | Complex 533-5

FUNCTION	ALLOWABLE LIMITS	RESULTS/VALUES
Turbopump Assembly Torque Check	Initial Break - 150 in.-lbs. Final Break - 50 in.-lbs. Running - 40 in.-lbs.	Initial Break - 50 in.-lbs. Final Break - 48 in.-lbs. Running - 40 in.-lbs.
		OHMS RESISTANCE
Electrical Resistance Test	Squibs: 0.5 to 1.0 ohm	A1 - 0.6 ohm B1 - 0.7 ohm
	PSVOR: 22.5 ohms	22.6 ohms
		LEAK RESISTANCE
	Greater than 10 K ohms	Squib A1 - 199.9 K ohms Squib B1 - 199.9 K ohms PSVOR - 199.9 K ohms
Thrust Chamber Valves Functional Check	Open 450 to 700 milliseconds Close 450 to 700 milliseconds External Leakage - None	Open - 635 milliseconds Close - 591 milliseconds No external leakage
Turbine Hot Gas System and Gas Generator Leak Check	Turbine Seal - 750 cc/minute Pressure Decay - 0 psig/5 min External Leakage - None Hot Gas Cooler Internal leakage - None/10 minutes Roll Control Bearing - 8 psig/5 min Roll Control Burst Diaphragm 0 psig/5 minutes	No seal leakage No pressure decay No external leakage No hot gas cooler leakage No bearing leakage No burst diaphragm leakage
	Fuel Autogenous Burst Diaphragm - None	No burst diaphragm leakage

Table II. Stage II Engine Checkout (Sheet 1 of 3)

TABLE 5.6-E

STAGE II ENGINE SN 9520107 (cont.)

Date: 23 April 1981 | Complex 533-5

FUNCTION	ALLOWABLE LIMITS	RESULTS/VALUES
Fuel System and Fuel Pump Seal Leak Check	Pump Seal - 900 cc/minute	No pump seal leakage
	Oil Cooler Internal - None/8 min	No oil cooler leakage
	Pressure Decay - 2 psig/5 min	No pressure decay
	External Leakage - None	No external leakage
Oxidizer System and Oxidizer Pump Seal Leak Check	Pump Seal - 900 cc/minute	No pump seal leakage
	Pressure Decay - 2 psig/5 min	No pressure decay
	External Leakage - None	No external leakage
Gearbox and Gearbox Seal Leak Check	Fuel GB Seal - 300 cc/minute	No fuel seak leakage
	Oxidizer GB Seal - 300 cc/min	No oxidizer seal leakage
	Pressure Decay - 0 psig/5 min	No pressure decay
	External Leakage - None	No external leakage
Downstream Propellant Systems Leak Check	GGFCKV Reverse Flow - 2 cc/min	0.5 psi/2 min GGVCKV leakage
	GGOCKV Reverse Flow - 2 cc/min	0.5 psi/2 min GGOCKV leakage
	Fuel Sys Press Decay - 0 psig/5 min	No pressure decay
	Oxid Sys Press Decay - 0 psig/5 min	No pressure decay
	External Leakage - None	No external leakage
Electrical Conduit Leak Check	Pressure Decay - 0 psig/2 min	No pressure decay
	External Leakage - None	No external leakage
Lube Oil Drain	Dipstick and Breaker Measure	Full on dipstick
	Quantity - 4-3/4 pints (2247 milliliters)	Breaker measurement not taken
	Screen contamination - None	Engine being returned for SLAP screen not removed for inspection
	Magnetic Plub Contamination - None	No particles on magnetic plug

Table II. Stage II Engine Checkout (Sheet 2 of 3)

TABLE 5.6-F

STAGE II ENGINE SN 9520107 (cont.)

Date: 23 April 1981

Complex 533-5

FUNCTION	ALLOWABLE LIMITS	RESULTS/VALUES
Engine Dew Point Check	+ 35°F - Maximum	Fuel System + 35°F Oxidizer System + 29°F
Roll Control Bearing Torque Check	400 inch-pounds max (actual)	224 inch-pounds (actual)

Table II. Stage II Engine Checkout (Sheet 3 of 3)

Engine SN	Orignial Delivery Date	After O/H Delivery Date	AGE* After O/H	Totals Firing Time	Cycles
9510102	25 Sept 1963	7 Oct 1965	187 mos	353 sec	3
9520107	23 Oct 1963	17 Nov 1965	185 mos	648 sec	7

* Time in silo was 105 months on each engine.

Testing of the engines consisted of all leak, functional, electrical, TPA torque and NDI inspections specified in T.O. 21M-LGM25C-103. These tests include all tests specified in T.O. 21M-LGM25C-2-2 which are performed in the silo following component time replacement, and 24 months thereafter, plus additional special tests specified for RASP only.

Tests and inspections performed during RASP activities indicated that both engines had been maintained in an excellent condition and were capable of supporting a successful operational mission. Several minor discrepancies were noted but none of these would have affected engine or system performance. Minor discrepancies are summarized in Report IR-068-01/I published under Contract F42600-81-D-0681, Aerojet Liquid Rocket Company and the relevant data for the Stage I and Stage II Engine Firings are presented within the tabulation sheets of Table 5.6 as following.

5.7 Missile B-79 Components Testing

The identification of missile components that are to be laboratory tested are listed below. Results of these tests will be submitted as an appendix to this report as they become available. See reference Appendix A and subsequent.

	Noun	P/N	NSN	Quantity
a.	Roll Control Actuator	PD46S0003-069	1420009556516AE	1
b.	Stage II Linear Actuator	PD46S0002-039	1420008772029AE	2
c.	Stage I Linear Actuator	PD46S0001-039	1420008852175AE	2
d.	Vernier Actuator	804A3720000-149	1420006793976AE	2
e.	Accumulator	PD48S0090-079	1420006825552AE	1
f.	Rate Gyro Package	804A3020300-009	1420010218349AE	1
g.	Autopilot	804A3020000-120	1420010218328AE	1
h.	Motor Driven Pump Alternate	PD48S0084-069 PD48S0084-529	4320009575278AE 4320009386923AE	1

i.	Stage II Oxidizer Prevalve	PD47S0140-419	4810000704446AE	1
j.	Stage II Engine Driven Pump	PD48S0087-019	1420008565727AE	1
k.	Stage II Fuel Prevalve	PD47S0136-199	4810000704442AE	1
l.	Impulse Cartridge	PD60S129-017	1336009016445	8
m.	Solenoid Valve	PD47S0138-019	4810009504096AE	1
n.	Stage I Engine Driven Pump	PD48S0089-029	1420009704735AE	1
o.	Stage I Fuel Prevalve or	PD47S0240-409	4810000720705AE	1
	Alternate	PD47S0137-379	4810000704443AE	
p.	Stage I Oxidizer Prevalve or	PD47S0137-379	4810000704443AE	1
	Alternate	804F2390000-010	4810000704444AE	1

5.8 <u>Test Conclusions</u>

All Phase I RASP tests were completed successfully. The overall condition of the missile and complex was satisfactory. Following is a list of some significant findings. The missile corrosion is of prime concern.

a. Silo door on Complex 533-5 exceeds time limits for door opening in accordance with Technical Order 35M-27-3-5-2. Total door opening time was 22.5 seconds. Possible cause is excessive time for lower "T" locks function of 3.7 - 5.0 seconds due to air in the system. Times were taken from tapes of the Silo Closure Opening Timing Test (SCOTTS). Unit was advised to recheck sometime after recycle and an additional sedentary period before making adjustments.

b. General Electric antenna #2, Complex 532-3 upper yoke arm for lifting the antenna door is bent. Cause is door travel in excess of Technical Order limits allowing door to slam open due to ineffective lift actuator snubber and worn out soft goods internal to the actuator. This allows yoke to travel past center, thus bending the yoke arm.

c. Light oxidizer powder residue and pitting on exterior of Stage II oxidizer tank below R.V., at Complex 532-8. Unit evaluation of pit depth and subsequent repairs required in accordance with T.O. 21M-LGM25C-3. Depot assistance may be required.

d. At Complex 532-8, missile skin, stringer, Vernier Rocket mounting hardware and wiring bundles Stage II engine area below Stage II Oxidizer F/D QD require corrosion treatment in accordance with T.O.s 21M-LGM25C-3 and 21M-LGM25C-101. Evidence of corrosion that has not been arrested is from a previously corrected leaking QD.

e. At Complex 533-5, missile skin, stringer, and Vernier Rocket mounting hardware in Stage II engine area below Stage II oxidizer F/D QD require corrosion treatment in accordance with T.O.s 21M-LGM25C-3 and 21M-LGM25C-101. Evidence of corrosion that has not been arrested is from a previously leaking QD.

f. At Complex 532-8, light powder and skin pitting on stringers, wiring and hardware of Stage II between tank area below Stage II oxidizer vent QD. Corrosion treatement required in accordance with T.O.s 21M-LGM25C-3 and 21M-LGM25C-101.

g. Stage I engine supports and attaching hardware show evidence of oxidizer corrosion at Complex 533-5. Corrosion treatment in accordance with T.O.s 21M-LGM25C-3 and 21M-LGM25C-101 is required.

h. During the performance of the simulator tests, Figure 2-10, T.O. 2-11-1, Missile Verification Malfunction Test, Step 43, the MFL failed to recognize a failure of the Stage I Rate Gyro. The remainder of the testing was completed. The cause of the failure should be determined during the checkout of the MFL-2 and MFL-3.

i. A complete propellant off-load and missile removal was monitored during this Phase I test. No major equipment anomalies were observed.

5.9 Selected Special Tests and Inspection

5.9.1 G.E. Antennas

McConnell A.F.B. Complex 532-3 G.E. Antennas No. 1 and No. 2 had both personnel access limit switches stuck in lowered position due to deteriorated seals that allow cover to ride excessively low onto switch. Antenna No. 1 Servicing QD Cap left off and PI-801 required adjustment to 1100 PSI. Antenna No. 2 upper yoke arm bent due to actuator travel, evidence of moderate water seepage at access cover seal and leakage of 500 PSI line bleed valve.

5.9.2 Corrosion Inspection Complex 532-8

At Complex 532-8, light powder and skin pitting on stringers, wiring and hardware of Stage II.

a. Between tank area below Stage II Oxidizer Vent QD.

b. Below Stage II F/D QD.

c. Exterior of Stage II Oxidizer tank below R.V.

Unit evaluation of pit depth and subsequent repair is required in accordance with T.O. 21M-LGM25C-3.

6.0 PHASE IA TEST - MISSILE B-74 AND COMPLEX 571-9

6.1 General

The Phase IA RASP Test of Missile B-74 at Davis Monthan AFB Complex 571-9 was completed between 12 and 27 February 1981. The Testing was conducted in conjunction with an unscheduled Stage II fuel download because fuel vapors were detected below Stage II Fuel Prevalve. A special test and inspection was performed on the following equipment as the result of propellant transfers.

a. RFHCO Ensemble

b. Mobile Propellant Transfer Equipment

c. Propellant Transfer System Pits

d. Missile Corrosion Inspection

The General Electric Antenna and the Battery Supply Systems were not tested under the RASP Phase IA Test because of the lack of a Nitrogen Tube Bank Trailer and an unserviceable Battery Charging Supply. The results of the RASP Testing however, indicated that missile and complex systems were generally in the ready condition and anomalies or discrepancies noted were minor and considered non-critical to launch capability.

6.2 B-74/29 Missile History

Missile B-74 (S/N 63-07729) was accepted by the Air Force in February 1964. After acceptance, the missile was shipped to the San Bernardino Air Material Area (SBAMA) at Norton AFB, where it was stored as a spare. During September 1965, the missile was shipped to Hill AFB as a part of transfer of System Managment to Ogden ALC. The missile was then transported to Davis Monthan AFB in December 1965 and was installed at Complex 571-9 in May 1966. Here it remained on alert until Phase I RASP testing in May 1976. After RASP testing, it was installed in Complex 570-1 in November 1976 and remained on alert until August 1979 at which time it was removed for an oxidizer manhole cover repair. Missile B-74/B-29 was reinstalled at Complex 571-9 in January 1980 where it remains on alert. Records show the following download history for B-74:

July 1972 - Oxidizer leak manhole cover

May 1976 - RASP testing

August 1979 - Oxidizer leak manhole cover

6.3 Coded Switch System (CSS) Test and Combined Systems Test (CST)

The CSS test was successfully performed at Complex 571-9 at the start of the Combined Systems Test.

A CST provides a go/no-go indication of the launch control equipment, OGE, OGE-to-missile interface, airborne wiring, and the IGS-to-flight controls interface. Attempts to obtain a successful CST at Complex 571-9 resulted in failure. Two failures were the result of a failed A-16 module; two more to a failed A-15 module in CMG-1 chassis. The last two failures resulted in Battery Hold due to Circuit Breaker #103 being "off" after a launch verification for CMG-1 chassis installation. Attempts to reprogram the BVL were unsuccessful because of a damaged J-4 connector which prevented "Memory Load Complete." This resulted in activating the BVL timer and subsequent removal of the BVL before further attempts could be initiated. A visual inspection of the BVL programmer SN 000001 performed by Technical Engineering revealed the programmer connector also had anomalies. Programmer was returned to depot for trouble analysis and repair.

Performance of a successful launch verification at the start of RASP testing provides confidence missile would have supported a launch attempt. Random failure of the CMG-1 chassis occurred after connecting the CST equipment and resulted in a "Guidance Hold". The missile at Complex 571-9 was scored ineffective due to a CMG-1 failure mode after the last good launch verification performance. Failed components were A-16 and A-15 Modules in CMG-1.

6.3.1 Motor Driven Switches

Motor Driven Switches (MDSs) were exercised during the CST and parameter results in terms of closure time and percent current were found to be well within specification requirements (See Table 6-1)

6.4 Operational Ground Equipment (OGE) Tests

6.4.1 Walk Through Inspection

No significant corrosion or leakage was observed during the walk through inspection of the eight silo levels at Complex 571-9. Pressure gauges on the accumulator rack assembly and the propellant tank pressure readings were within specification.

OGE Electrical 28VDC Battery Power Supply No. 2 has Top Cap that was cracked on Cell 026, otherwise, appearance was ok. A noisy fan bearing was apparent on the blower.

6.4.2 Thrust Mount and Shock Isolation System Tests

The following tests were accomplished during the Phase IA testing at Complex 571-9 on the Thrust Mount and Shock Isolation System:

a. A visual alignment check was performed to determine if the system was in proper alignment within the lockup range.

b. A lockup exercise was performed during a Launch Verification to verify proper system operation.

c. An external inspection of system components for corrosion, damage, missing hardware and general deterioration resulting from the operational environment was performed. A visual inspection was conducted which included the suspension spring assemblies, vertical and horizontal dampers, ball screw jack assemblies, and the thrust ring. No discrepancies were noted.

These tests were used to evaluate its capability to function during a normal launch and to determine if it would return to lockup range setting. A check of the ball screw jack settings showed that the thrust mount was properly adjusted for equalized load as required in T.O. 21M-LGM25C-2-13.

6.4.3 Silo Closure Door System

The Silo Closure Door System was exercised and the incremental times for door open and close functions are shown below.

571-9 Incremental Door Times

Function	Recording Time (sec)	T.O. Requirement (sec)
Unlock "T" Locks	1.25	1.5 ± 0.5
Lower "T" Locks	2.7	2.5 ± 0.5
Raise Rail Bridge Jacks	1.6	2.0 ± 0.5
Door Roll Open	12.5	13.0 ± 1.0
Total Door Opening	18.8	19.0 ± 2.0

NOTE

Incremental operating times will be checked only when the time for overall operation exceeds 19.0 ± 2.0 seconds.

Accumulator Capability

Function	Nitrogen Pressure (PI 403) (psig)	Hydraulic Pressure (PI 402) (psig)	Fluid Level (in.)
Start	3500	3500	3½"
Door Open	3100	3100	6½"
Door Closed	2950	2950	11½"
Hydraulic Fluid Released to Reservoir	2850	0	13½"
System Recharged by Hydraulic Pump	3500	3500	4½"

TABLE 6-1

Missile B-4 Complex 571-9 Motor Driven Switch Performance

Switch Position	Function	Type Switch (amp)	First Cycle Time (msec)	System* Requirement	T.O. Req'mt. Time (msec)	% Local Current	T.O. Req'mt. %Local Current
685K2	Stage I Engine Start Switch	20	57	1 sec	72	50	75
685K1	Stage I Prevalve Switch	20	55	1 sec	72	50	75
364K2	Stage I Staging and Shutdown Switch	20	60	200 msec	72	50	75
331K3	Stage II Engine Shutdown Switch	20	35	197 msec	72	45	75
364K1	Ordnance Safety Switch	20	55	1 sec	72	50	75
331K1	IGS Power Switch	20	64	1 sec	72	45	75
331K2	APS Power Switch	200	50	1 sec	72	49	75
367K1	VHPS Power Switch	200		1 sec	72	50	75

*Allowable Operational Tolerance

Inspection of the drive unit during the walk-through inspection showed minor leakage of the case seal and both pistons had moderate leakage. This is a typical condition for the large unit. Drive cable and drum wear were minimal.

The power unit inspection showed a normal reservoir level. The pressure filter FLT-401 indicator was down, showing that the filter was not clogged. There was no leakage noted.

6.4.4 Missile Isolation Resistance Check

The missile isolation resistance check performed on 21 February 81 provided a resistance reading of 10,000 ohms which is the required specification value.

6.4.5 Support Equipment Inspection

The inspection of Complex 570-8, 570-9 and 571-9 Propellant Transfer System and Pits was performed. Excessive corrosion or moisture damage was observed on RP-1 Panel Assemblies. Electrical wiring showed considerable tinting and corrosion because of water in the junction box.

6.4.6 OGE Power Supply Equipment Checks

The OGE Power Supply Equipment consists of a power distribution control rack, two 28 vdc power supplies, two 28 vdc battery power supplies, and two interconnecting boxes.

A visual inspection of the power supplies, and battery power supplies showed Cell 026 in BPS-1 had a cell cracked and fan bearings were noisy on BPS-2. Otherwise, the equipment showed it was well maintained, with little apparent damage or corrosion.

Terminal tightness checks of the terminals in connecting boxes JEU-18 and JEU-19 revealed no loose terminals.

The parameters recorded for the power supplies and battery power supplies during the inspection are shown below.

571-9 OGE Electrical Parameters

Parameter	Measurement	Normal Limits
Power Supply #1 Output (vdc)	32.0	29.5 - 32
Power Supply #2 Output (vdc)	30.8	29.5 - 32
Battery Power Supply #1 Output (vdc)	36	31 minimum
Battery Power Supply #2 Output (vdc)	35	31 minimum

6.4.7 Launch Duct Humidity Check

A check of the launch duct air humidity was made using a sling psychrometer on Levels 2 and 7 of the launch duct and a check of the relative humidity reading near the dehumidifier, D-101, on Level 8 was obtained. The following were the measurements taken at Complex 571-9:

	Relative Humidity (%)	T.O. Requirments (%)*
Level 2 Launch Duct	22	30% MAX
Level 7 Launch Duct	21	30% MAX
Level 8 Dehumidifier	21	30% MAX

*SAC CEM 21-SM68B-2-20-Series

6.4.8 Pressurization System

Phase IA testing of this system consisted of a check of tank pressures on the Propellant Tank Pressure Monitor. The following table shows the tank pressure recorded on Missile B-74.

TANK	PRESSURE (PSIG)	NORMAL RANGE (PSIG)
Stage I Oxidizer	12.4	9.5 to 13.5
Stage II Oxidizer	41.5	36.2 to 43.9
Stage I Fuel	12.0	9.5 to 15.5
Stage II Fuel	36.3	33.2 to 40.9

The test results indicated the system was capable of a successful mission.

6.5 Missile Airframe

6.5.1 Missile Inspection

Missile corrosion inspection findings were as follows:

- Stage I oxidizer tank manhole cover 3 bolts leaking. (Previously documented)
- Stage I Sub 1 Dead leg drain-minor salt crystals around pressure cap.
- Stage I Sub II-minor oil & corrosion residue on exterior of TPA.
- Stage I Fuel Autogenous line shows minor corrosion on tank outlet below marmon clamp.
- Stage I Oxidizer Vent QD area between outboard marmon clamp and QD surface-minor corrosion.
- Stage I Oxidizer Vent QD pressure cap-minor salt crystals.

- Missile skin and tank chem-mil area on both stages shows evidence of power tool usage during corrosion treatment.
- Minor skin corrosion and pitting on Stage II Engine compartment in Fill & Drain QD area.

Overall, missile S/N 62-12299 has been corrosion treated and maintained in an outstanding manner. The one exception, is the power tool usage during corrosion treatment. Power tools and abrasives should never be used to perform any missile skin or tank area corrosion control.

6.5.2 Airborne Electrical

a. Airborne Wiring

The basic continuity and mission capability of the airborne wiring is demonstrated by the CST. A visual inspection and successful CST demonstrated the mission capability of the airborne wiring system.

b. Airborne Connector Inspection

The missile airborne connectors, receptacles and attaching electrical harnesses are inspected for damage using a 10X illuminated magnifier. Appearance of connectors was excellent due to the unit initiated inspection procedures for all wing assets.

c. Airborne Interconnecting Box #1 Capacitor

The Airborne Capacitor and Interconnecting Box #1 Capacitor insure power surges and ripples are filtered out prior to entering the IGS. The results of each test indicated the capacitors would perform as designed.

6.5.3 Airborne Hydraulics

A Hydraulic Pump Noise Test was performed to monitor the A.C. voltage ripple on the airborne bus. This test was accomplished utilizing the Hydraulic Control Unit (HCU), thus, eliminating unnecessary operation of airborne and ground support equipment. Both Stage I and Stage II Electric Driven pumps exhibited low peak-peak voltage spikes. Stage I was 3.0 PPV and Stage II was 4.5 PPV.

6.6 Special Selected Testing and Inspection

6.6.1 Propellant Transfer System and Pit

a. <u>Complex 571-2</u>

- RP-1 circuit breaker panel corroded and wires show signs of wicking and corrosion.
- TC-13 cloth covered wires have heavy accumulation of fungus/mold and corrosion.
- 115 VAC receptacles corroded.

b. <u>Complex 570-6</u>

- RP-1 circuit breaker panel-approximately ½" of water in bottom of panel, box corroded, and wires are corroded to circuit breakers.
- P-15 Sump pump inoperative in both Auto or Hand position. Sump full of water.
- 115 VAC light inoperative.

c. <u>Complex 570-9</u>

- 115 VAC receptacles corroded.
- RP-1 Circuit breaker panel corroded inside and wires to circuit breakers corroded.
- Facility grounds require corrosion treatement.
- 115 VAC circuit breaker C-11001-0 corroded.

6.6.2 G.E. Antenna Inspection –

No antenna inspection performed due to shortage of serviceable tube banks.

6.6.3 Mobile Propellant Transfer Equipment

a. <u>Fuel Holding Trailer SN L05907</u>

- Minor corrosion
  (1) Relief Valves on top of pump
  (2) 4" pipe 10' up from V-246
  (3) 50 PSI line to TSV-230
  (4) Fire Water System over trailer minor corrosion.
  (5) Chains corroded on valves V-242 & 304
- 13 poly bags of fuel contaminated parts left on trailer

b. <u>Fuel Transport Trailer SN 62L1427</u>

- Minor corrosion in Manway equipment area
- RV-2 Vent line bolts (Stainless Steel) painted
- V-12 Flange to Flange seal twisted
- Potential fire hazard - Trailer chocks are wood.

c. <u>Oxidizer Holding Trailer SN FRC156508</u>

- LLI compartments corroded
- Stage I pump suction line (TI 275X1E) leaking
- F-101 Stage I, leaking at marmon clamp
- Floor surface requires corrosion treatment
- Pump wires scraped inside conduit
- Stage I/II pumps require corrosion treatment
- PSV-203 corroded at flange.

6.7 Test Summary

The results of the RASP testing conducted on Missile B-74/29 indicated that the system was generally in a well maintained ready condition. There were, however, some anomalies and/or discrepancies noted during the test and these are summarized in the remainder of this section.

Prior to connect and accomplishment of a Combined System Test (CST) a successful launch verification must be performed. This was done by the Missile Combat Crew on 15 Feb 1981. Sortie would have supported a launch. The CST equipment was connected, calibrated, and prepared for running the CST on 17 Feb 1981. Attempts to obtain a successful CST 17-19 Feb 81, resulted in successive failures of the Control Monitor Group (CMG-1) chassis. Subsequent trouble analysis revealed failures of the A-16 and A-15 modules within CMG-1 chassis on the Guidance Electronic Equipment Test Set (GEETS) at the MIMS.

Inspection of the Propellant Transfer System pits on complexes 571-2, 570-9 and 571-9 disclosed corrosion accumulation was significant within RP-1 circuit breaker panels along with fungus and corrosion in Terminal Cabinets TC-13 and 115 VAC receptacles.

Six RFHCO ensembles were highlighted requiring new rigid arm cuffs. Two of the six had recently been returned from depot repair facilities at Kennedy Space Center. An apparent lack of serviceable arm cuffs had rendered six ensembles unserviceable. One ensemble returned from depot would not pass the leak test due to stitches not being covered with a layer of butyl. More stringent quality control is required to insure serviceable assets.

Nitrogen tube bank trailers require periodic hydrostatic testing to insure serviceability. Each of the three Titan Wings has a different Major Air Command host on their respective bases; therefore, when tube bank trailers require hydrostatic testing, each unit sends the trailers to different contractor facilities for testing. This results in considerable delay between departure and return dependent upon the contractors work load. Standardized hydrostatic test facilities would reduce turn-around time, reduce over cost factors and enhance unit scheduling if implemented.

7.0 PHASE IA TEST - MISSILE B-63 AND COMPLEX 374-2

7.1 General

Phase IA RASP Testing of Missile B-63, Complex 374-2, Little Rock AFB, was completed between 15 and 25 June 1981. A satisfactory launch verification was performed.

7.2 Missile B-63 History

Missile B-63 was accepted by the Air Force in November 1963 and shipped from the Martin Company to Little Rock AFB, where it was installed in Complex 374-2 in Dec. 1963 and placed on alert status. B-63 was removed from Complex 374-2 in May 1966 for yard fence modification. The missile was then re-installed in Complex 374-2 in June 1966 and maintained on alert.

The records show the following down-load history for Missile B-63:

Sept 72 - OX Stage I & II Seals
June 73 - OX Stage II - M/H Cover & Fill & Drain
Sept 75 - OX Stage I & II Seals
Aug 76 - OX Stage I & II L/L Sensor Leak
Aug 78 - OX Stage I & II Seals

7.3 Coded Switch System (CSS) & Combined System Test (CST)

The CSS and CST provides a go/no-go indication of launch control and ground support equipment as well as Ground Support Equipment-to-missile interface and airborne wiring IGS-to-flight control interface. The CST and CSS Tests were successfully performed at Complex 374-2.

All eight Motor Driven Switches (MDSs) were exercised during the CST and performance parameters in terms of closure time and percent current were found to be within specification (See Table 7-1).

7.4 Operating Ground Equipment (OGE) Tests

7.4.1 Walk Through Inspection

Complex Corrosion Inspection - No significant corrosion damage was observed during the walk-through-inspection of the eight silo levels. Support equipment status inspection had the following write-up.

Support Equipment Status

Level 1 - OK
Level 2 - WC-103 shut down
Level 3 - OK
Level 4 - OK
Level 5 - OK
Level 6 - OK
Level 7 - P-104 outlet valve CV-3E0580-0 packing retainer broken
Level 8 - OK
Level 9 - Could not be entered due to safety requirements

TABLE 7-1

Missile B Complex Motor Driven Switch Performance

Switch Position	Function	Type Switch (amp)	First Cycle Time (msec)	System* T.O. Requirement	Req'mt. Time (msec)	% Local Current	T.O. Req'mt. %Local Current
685K2	Stage I Engine Start Switch	20	52	1 sec	72	11.1	75
685K1	Stage I Prevalve Switch	20	58	1 sec	72	11.1	75
364K2	Stage I Staging and Shutdown Switch	20	55	200 msec	72	17.1	75
331K3	Stage II Engine Shutdown Switch	20	59	197 msec	72	11.1	75
364K1	Ordnance Safety Switch	20	65	1 sec	72	11.1	75
331K1	IGS Power Switch	20	52	1 sec	72	16.7	75
331K2	APS Power Switch	200	47	1 sec	72	11.1	75
367K1	VHPS Power Switch	200	49	1 sec	72	13.3	75

*Allowable Operational Tolerance

7.4.2 Thrust Mount and Shock Isolation System

The system functioned normally as substaintiated by the launch verification. A check of the ball screw jack settings showed that the thrust mount was properly adjusted for equalized load as required in accordance with TO 21M-LGM25C-2-13.

The visual inspection of the springs, jacks, dampers, and thrust ring did not reveal any significant discrepancies.

7.4.3 Silo Closure Door

The test was performed on 5 June 1981 and the door operated satisfactorily. The incremental time for door functions and the data gathered to show the capability of the HS-1 System to open and close the door utilizing nitrogen storage system are as follows:

374-2 Incremental Door Times

Function	Recording Times (sec)	T.O. Requirements (sec)
Unlock "T" locks	1.0	1.5 ± 0.5
Lower "T" locks	4.0	2.5 ± 0.5
Raise rail bridge jacks	1.6	2.0 ± 0.5
Door roll open	13.1	13.0 ± 1.0
Total door opening	20.4	19.0 ± 2.0

Accumulator Capability

Function	Nitrogen Pres (PI 403) (psig)	Hydraulic Pres (PI 402) (psig)	Fluid Level (in.)	TO Requirements (psig) (in.)
Start	3500	3500	5.0	(3315 to 3525) (1" to 5")
Door Open	3100	3100	7.75	(n/a) (n/a)
Door Closed	2900	2900	12.0	(n/a) (n/a)
Hydraulic Fluid Released to Reservoir	3000*	0	12.5	(0/2850 ± 50) (n/a)
System Recharged by Hydraulic Pump	3550	3550	6.0	(3315 to 3525) (1" to 5")

* The HS-1 fluid level and nitrogen precharge were above T.O. limits. Unit personnel documented the discrepancy for futher trouble analysis. Possible cause of trouble is one or more accumulator pistons being stuck.

7.4.4 Missile Isolation Resistance Check

The resistance value was found to be out of tolerance and trouble analysis found the K-5 ground control relay to be defective. The problem was documented and the technical engineering personnel will follow-up on corrective action.

7.4.5 Motor Driven Switch Test

The motor driven switch performance parameters for closure time and percent of peak current, which were measured during the Combined Systems Test, indicated that all switches performed within system requirement.

7.4.6 OGE Power Supply Equipment Checks

A visual inspection of the equipment showed it to be well maintained with no apparent damage or corrosion.

The operating parameters recorded for the power supplies and battery power supplies are shown below.

374-2 Electrical Parameters

Parameter	Measurement	Normal Limits
Power Supply #1 Output (vdc)	30.8	29.5 - 32
Power Supply #2 Output (vdc)	30.0	29.5 - 32
Battery Power Supply #1 Output (vdc)	31.4	31 minimum
Battery Power Supply #2 Output (vdc)	31.5	31 minimum

7.4.7 Pressurization System

Phase IA testing of this system consisted of a check of tank pressures on the Propellant Tank Pressure Monitor Unit. The following table shows the tank pressures recorded on Missile B-63.

Tank	Pressure (psig)	Normal Range (psig)
Stage I Oxidizer	12.3	9.5 to 13.5
Stage II Oxidizer	39.2	36.2 to 43.9
Stage I Fuel	12.9	9.5 to 15.5
Stage II Fuel	38.6	33.2 to 40.9

The tank pressures which were recorded indicated the system was capable of a successful mission.

7.4.8 Launch Duct Humidity Check

A check of the launch duct air humidity was made using a sling psychrometer on Levels 2 and 7 of the launch duct and a check of the relative humidity reading near the dehumidifier, D-101, on Level 8 was obtained. The following were the measurements taken at Complex 374-2.

	Relative Humidity (%)	T.O. Requirement (%)*
Level 2 Launch Duct	49%	30% MAX
Level 7 Launch Duct	63%	30% MAX
Level 8 Dehumidifier	62%	30% MAX

*SAC CEM 21-SM68B-2-20-Series

The launch duct and equipment area humidity were out of T.O. limits. D-101 was operating normally. No equipment malfunction could be identified to determine the cause of the high humidity condition.

7.5 Missile Airframe

7.5.1 Missile Inspection

Missile B-63 has been exposed to high moisture and oxidizer vapors at some time because most of the exterior of the airframe has mild pit corrosion. The pit corrosion has been treated, but some mild corrosion was observed in the following areas.

a. Stage II oxidizer tank barrel

b. Stage II fuel tank barrel

c. Stage II engine T.P.A.

d. Stage I oxidizer tank under the vent QD down to Stage I fuel tank.

Missile B-71, Complex 373-8 Little Rock AFB, AR. was selected for an additional missile corrosion inspection. This missile had previously been inspected in Nov. 1980 during a Phase 1A RASP test, but it had been subjected to two fire water spray ring activations since the last inspection; therefore, it was chosen for re-inspection. The required maintenance actions which were performed, and arrested further corrosion. The missile was in an outstanding condition. Only three minor areas of corrosion were found in the Stage I engine area, but there were signs that power tool usage for corrosion control had occurred at some earlier date.

7.5.2 Airborne Electrical

a. Airborne Connector Inspection

The missile airborne connectors, receptacles, and attaching electrical harnesses were inspected using a 10X illuminated magnifier. Results of the inspection are as follows:

- Stage II Start Cartridge (375J1) - OK, but alignment sleeve is worn.
- Stage I Sub 1 Start Cartridge - OK, but shows signs of having been misaligned at some time.

b. Airborne Electrical Wiring

A visual inspection and a successful CST on 18 June 1981 demonstrated the mission capability of the airborne wiring system.

c. Inertial Guidance System

Test results from LRAFB Launch Complex 374-2 indicate that nominal parameters were obtained for guidance system performance and that this system was capable of performing its assigned mission with the required accuracy. (Delco Electronics-Interim Report)

7.5.3 Airborne Hydraulics

Hydraulic Pump Noise Test - Both Stage I and Stage II Electric Driven Pumps exhibited acceptable peak-to-peak voltage.

7.6 Support Equipment Test

During this Phase IA testing the hydraulic components test stands (AE42T-1 and AE42T-2) were tested. These test stands provide test and checkout capability for airborne, HS-1, HS-2, HS-3, and HS-4 components. The two test stands were inspected and operated IAW T.O. 33D9-4-9-1 (AE42T-1) and 33D9-19-1 (AE42T-2). Each test stand operated properly and was in an outstanding condition.

7.7 Selected Special Tests and Inspections

7.7.1 G.E. Antenna Inspection

A G.E. soft and hard antenna checkout was performed. The soft and hard #1 antenna operated properly. Pneumatic pressure lines, electrical conduits, and limit switches were all in good condition. The electrical cabling for the limit switches indicated that the internal wire insulation had hardened.

7.8 Test Conclusions

Phase IA RASP Testing of Missile B-63 at Complex 374-2 indicated that the weapon system was in a ready state and would have supported a launch.

8.0 DISTRIBUTION

IDA

HQ USAF

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AF/LEYW
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Director of Aerospace Safety

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3416 TECH TNG SQ/TTV

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MMIR
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CC
MMG
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MMIR
MMI
ACDCS
HQ

HQ SAC

LGY
LGBT
HQ SACCA/LGB
XOBML
XPQO
DOMV

DEL
3901 SMES/MB
DCXS

AD

12 AD/LG
19 AD/LG
42 AD/LG

1 STRAD

1 LGBM
1 LGL
DOVT
4th STRMD/CCE
BM

SMW

308 CC
308 MB
308 MBSE
308 MBQ
308 MIM/CC
381 CC
381 MB
381 MBSE
381 MBQ
381 MIM/CC
390 CC

390 MBSE
390 MBQ
390 MIM/CC

Numbered AF

15 AF LGEA
15 AF LGB
8 AF LGEA
8 AF LGB

SMS

394/LGBAT (Titan)

AFSC/SD

LVXT

AFSC/BMD

AWG
LX/AFLC (AQS)

SAMTO

HQ Foreign Tech Div

PDBI

Contractors

TRW/DSSG
Martin Marietta (Denver, CO)
Martin Marietta Aerospace (Vandenberg AFB)
Delco Electronics
Aeroject Services Company
Defense Document MM (DDC/TCA)
Space Division/YVX (Los Angeles AF Station)

APPENDIX DATA SHEET 1 - STAGE I BOOSTER ACTUATOR - S/N 0000835

1.0 INTRODUCTION

This report summarizes the results of the Reliability and Aging Surveillance Program (RASP) and subsequent tear down and inspection for softgoods evaluation for the following Titan II hydraulic component:

Part Name:	Stage I Booster Actuator
Part Number:	PD48S0001-039
FSN:	1420-00-085-2175 AE
Serial Number:	0000835
Assembly Date:	3 Q 63

This unit was removed from missile B-79.

2.0 TEST RESULTS

The actuator exhibited a marginal internal leakage of 1.4 cu. inch per sec (CIS), which exceeds specification limit of 1.35 CIS. The marginal leakage condition is not considered catastrophic. The unit passed all other performance requirements. The test results are tabulated in the engineering report data sheets as published, October 1981 by Martin Marietta Corp. - Denver under Contract F42600-82-C-0010.

3.0 SOFT GOODS EVALUATION

The actuator was disassembled and the softgoods examined. The desired o-rings were removed and physical dimensions and durometer readings were taken. The o-rings appeared to be pliable and resilient with very little permanent set. The physical dimensions and durometer readings are tabulated in the attached data sheet. The o-rings were delivered to TRW for further evaluation.

4.0 CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the cause of the marginal internal leakage is in the actuator servo-valves main spool and bushing due to normal wear. The amount of internal leakage exhibited is not catastrophic. (Internal leakage is catastrophic only if it exceeds the pumps output capability).

It is recommended that the actuator be returned to stores as a repairable unit.

APPENDIX DATA SHEET 2 - STAGE I BOOSTER ACTUATOR - S/N 000892

1.0 INTRODUCTION

This report summarizes the results of the Reliability and AGE Surveillance Progam RASP and subsequent teardown and inspection for softgood evaluation for the following Titan II hydraulic component.

Part Name:	Stage I Booster Actuator
Part Number:	PD48S0001-039
FSN:	1420-00-885-2175 AE
Serial Number:	000892
Assembly Date:	1 Q 64

This unit was removed from missile B-79.

2.0 TEST RESULTS

The unit exhibited excessive null bias current (1.4 ma, specification limit: $\pm$ .80 ma). The out-of-tolerance condition is not flight catastrophic. The unit passed all other performance requirements. The test results are tabulated in the engineering report data sheets as published October, 1981 by Martin Marietta Corp. - Denver under Contract F42600-82-C-0010.

3.0 SOFT GOOD EVALUATION

The unit was disassembled and the softgoods examined. The desired o-rings were removed and physical dimensions and durometer readings were taken. All the components appeared to be in good condition with no indication of excessive wear. The o-rings appeared to be pliable and resilient with very little permanent set. The physical dimensions and durometer readings are tabulated in the attached data sheet. The o-rings were delivered to TRW for further evaluation.

4.0 CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the excessive null bias current represented approximately only 3.5% loss of control authority in one direction and therefore not flight catastrophic. The cause of the out-of-tolerance condition is probably due to shifts in the actuator servo-valve and/or feedback mechanism due to handling and for transportation.

It is recommended that the actuator be returned to stores as a repairable unit.